Raytheon

Customer Success Is Our Mission

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LAND
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Water Use Reduction Initiative

Larry Bryan
Manager, EHS

Kevin Newby
Facility Planning & Design

Raytheon Indianapolis

Raytheon Company at a Glance

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William H. Swanson
Chairman and CEO

2012 Revenues: $24 billion
Employees: 68,000
Headquarters: Waltham, MA

Raytheon Company (NYSE: RTN) is a technology and innovation leader specializing in defense, security and civil markets throughout the world.

Business Units:

- **Integrated Defense Systems (IDS)** provides integrated naval, air and missile defense, domain awareness systems and homeland security solutions
- **Intelligence, Information and Services (IIS)** provides a full range of ISR, cybersecurity, training, space, logistics and engineering solutions for the intelligence community, government and civilian customers
- **Raytheon Missile Systems (RMS)** provides advanced missile systems and solutions for the armed forces of the U.S. and allied nations
- **Space and Airborne Systems (SAS)** provides sensors, communications, integrated systems and space solutions for defense, government and commercial customers

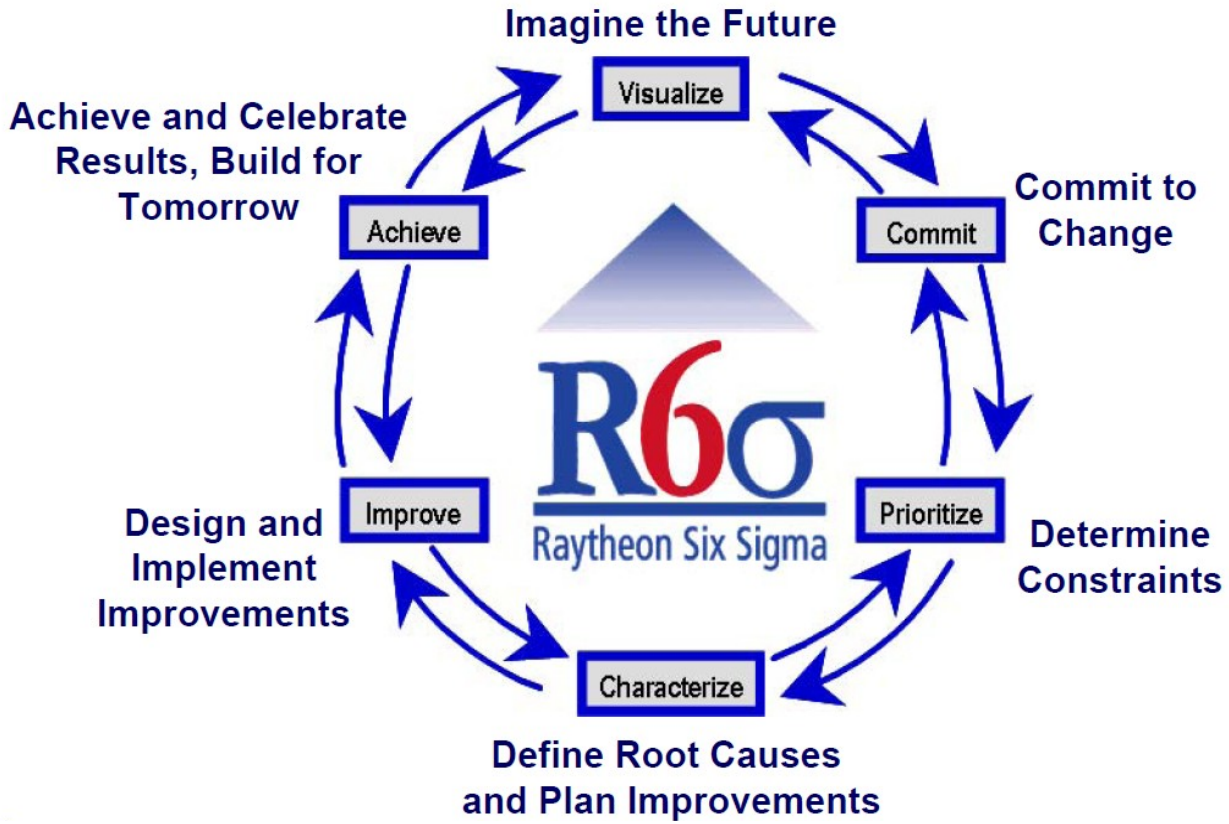
Raytheon Company at a Glance (cont.)

Indianapolis Campus – Systems Modernization & Sustainment – *Through research and innovation, we make systems new again or better than new.*

Former Naval Avionics facility built in 1942 to manufacture the Norden bombsight – 1 million square feet under-roof on 169 acres – approx. 1,000 employees today.

Water Use Reduction Initiative

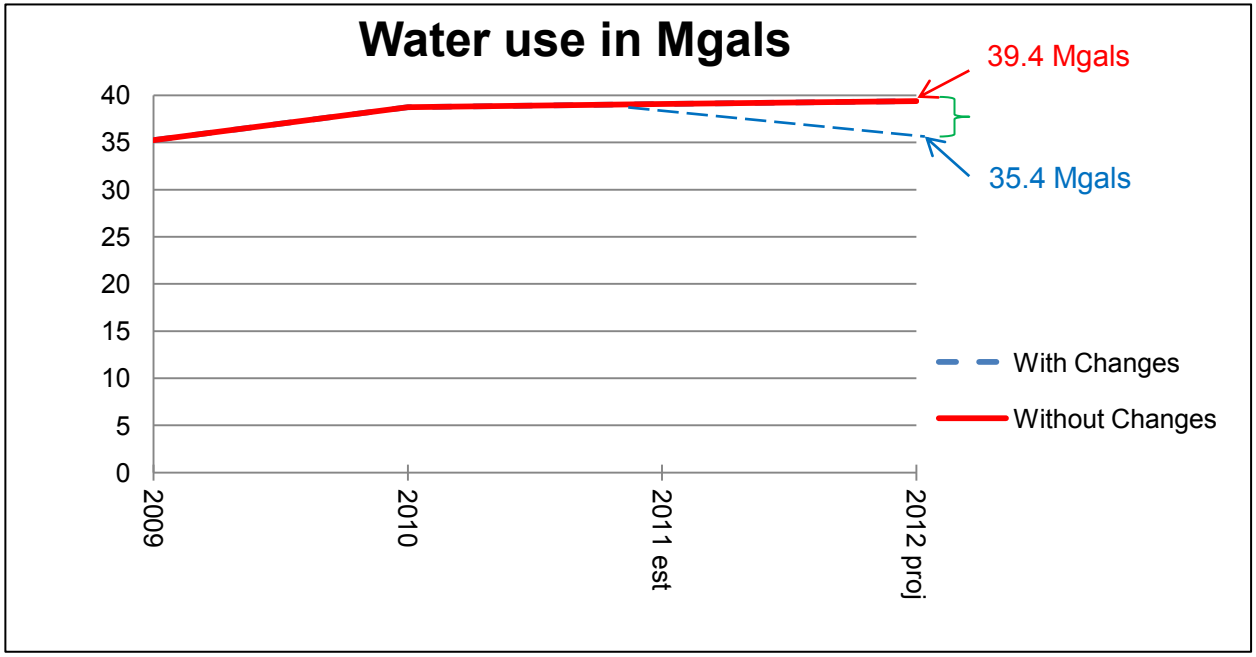
- Developed as a Raytheon Six Sigma (R6s) project



Can easily be achieved outside of the Six Sigma process.

Background

- Raytheon's sustainability goals include reducing water usage by 25 percent from 2008 to 2015
  - Specific project target was 10 percent = 4 million gallons



Vision

- Only Assumptions
  - Annual water use is excessive
  - Opportunities exist to reduce usage

- Not only environmentally responsible, but also financially responsible given the trend of water rate increases

Year	=	Domestic	+	sewer	=	total water cost	
2010	=	$1.83	+	$2.75	=	$4.59	
2011	=	$2.52	+	$3.42	=	$5.94	29% ↑
2012	=	$2.63	+	$3.94	=	$6.57	11% ↑
2013	=	$2.68	+	$4.36	=	$7.04	7% ↑

Process

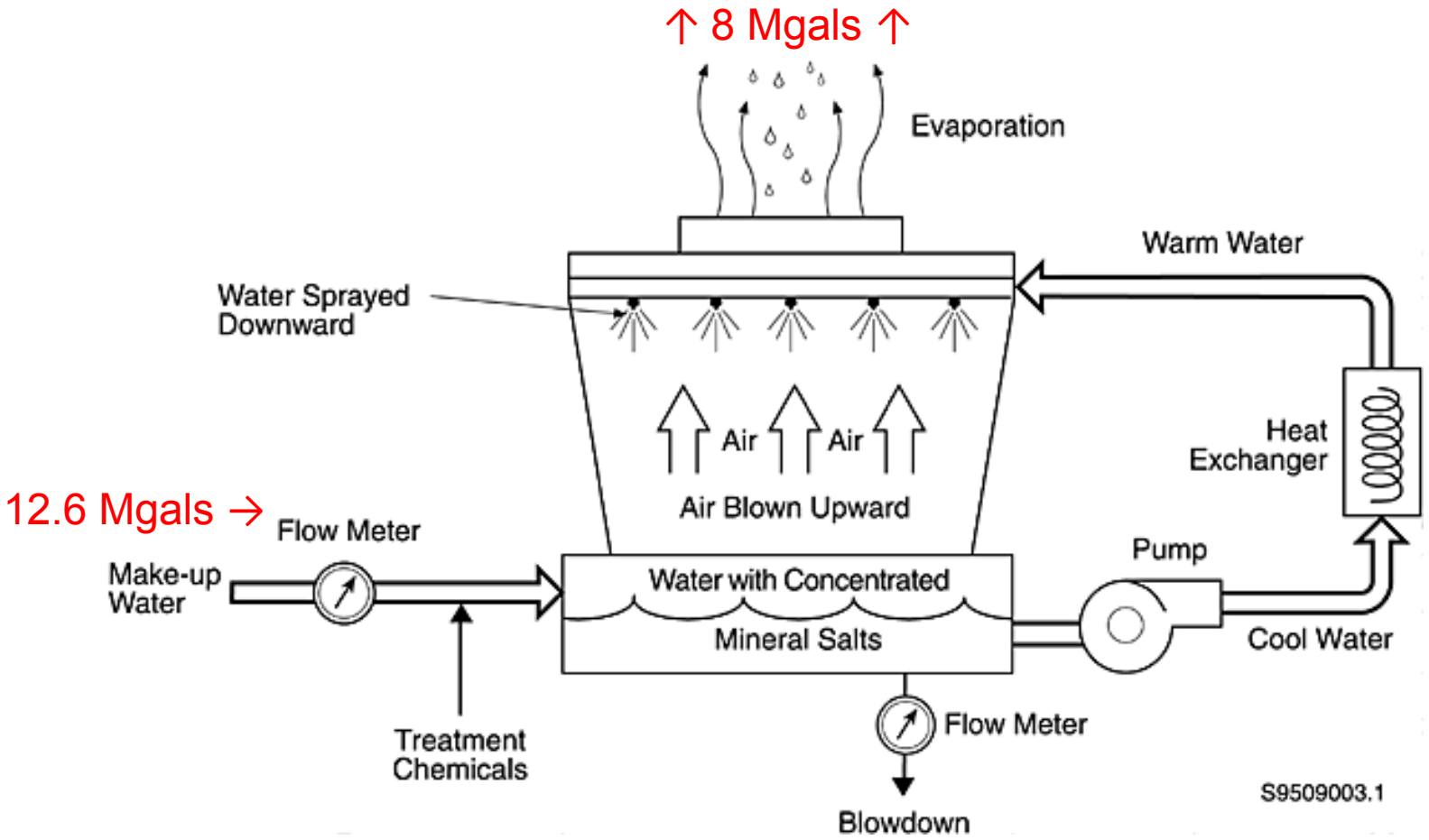
- Data gathering for 12-month period
  - Heavy hitters only
  - Utility bills – water, sewer, monthly evaporative credit
  - Existing meters on main processes
    - Cooling tower – make up/blow down meters
    - Reverse osmosis system (RO) and deionized (D.I.) controllers
    - Water softening/conditioning
    - Plating
  - Building automation systems
  - Engage water-treatment vendor

Review Data

Total consumption – 38.8M gallons		
Cooling Tower Makeup	12.6 Mgals	32%
R/O System - Boilers	6.7 Mgals	17%
R/O System - Plating	4.1 Mgals	11%
R/O System for one process	1.1 Mgals	3%
	24.5 Mgals	63%

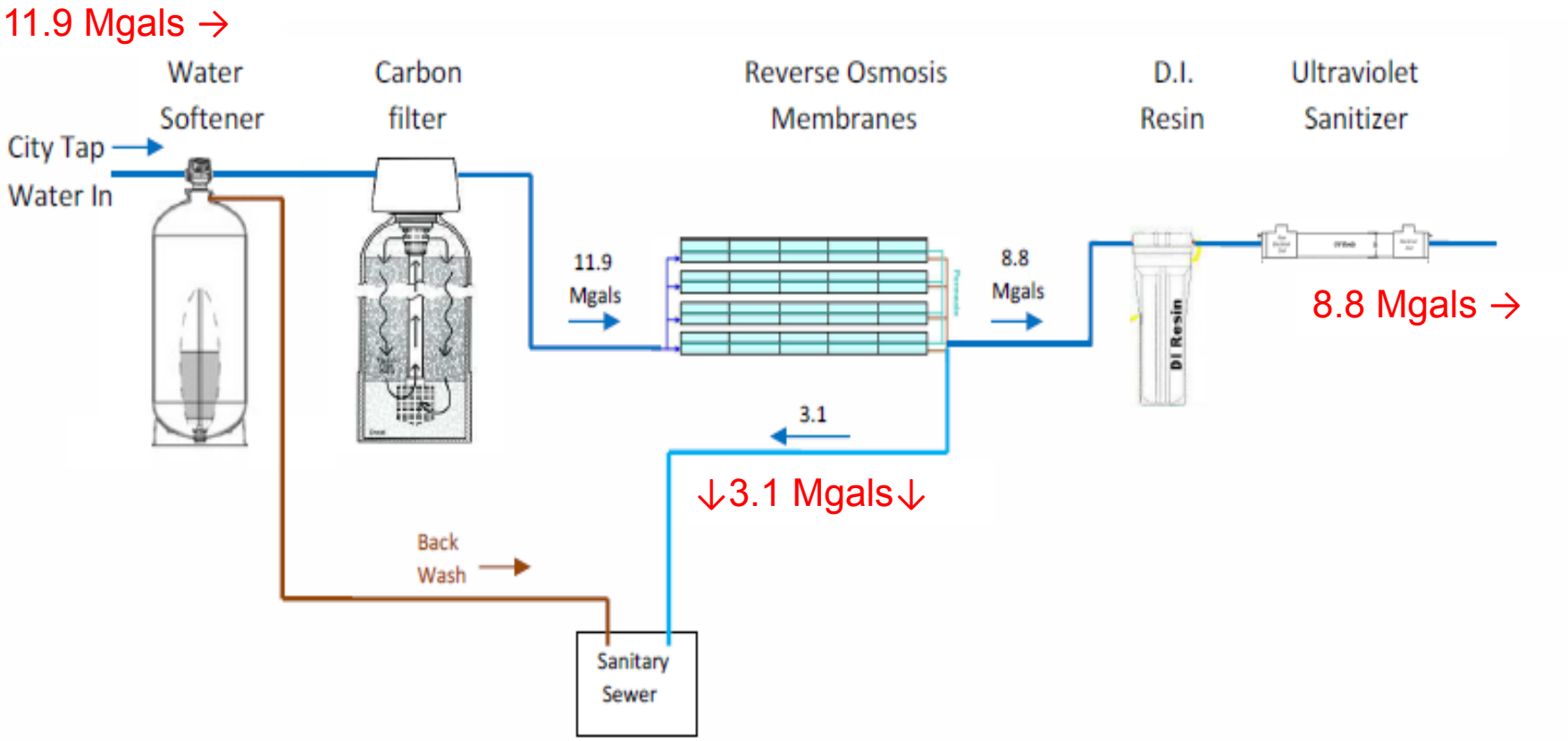
Review Data (cont.)

- Cooling Tower



Review Data (cont.)

- RO/DI Systems



Analyze High-Use Processes

- Validate Current Need
  - Does the original need still exist?
  - Can it be replaced?
- Evaluate Process
  - Can the process be improved to reduce water consumption?
  - Is there a means to capture or reclaim waste water?
- Envision Change
  - Entertain all “what if” scenarios
- Consider additional Opportunities
  - Rainwater harvesting
  - Re-commission two existing water reservoirs

No pre-conceived ideas … entertain all options

Constraints

- Minimize impact on plant operations – involve department managers
- Prevent cross-contamination – use backflow preventers
- Cooling tower uses evaporative cooling – ~~geothermal~~
- Tower water must be chemically balanced– sample reclaimed

Design, Cost Estimates, RoI & Recommendations

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- Weighed each idea - “green”, cost and return on investment

R6s Water Conservation Project	Annual Savings Mgals	Annual Savings $$$	Initial Investment Material	Labor	Total	Returned in
A. B1200 RO Reclamation	1.161	$6,896				
Cost Estimate			$1,298	$1,004	$2,303	4 months
B. B1300 RO Decommission	1.054	$6,261				
Cost Estimate			$500	$1,000	$1,500	3 months
C. B6000 RO Reclamation	1.629	$9,676				
Cost Estimate			$5,465	$6,121	$11,587	14 months
D. B6000 Rainwater Harvesting (Roof Drains)	0.164	$425				see note
Cost Estimate			$2,214	$3,158	$5,372	13 years
E. B6210 Rainwater Harvesting (Roof Drains)	0.092	$238				see note
Cost Estimate			$2,147	$2,352	$4,499	19 years
F. B1000 - B1200 (HALF) rainwater Harvesting	8.700	$22,446				
Cost Estimate			$23,370	$23,332	$46,702	2 years
Total Water Saved=>	12.800	$45,942				

Notes:
Projects D and E show a long ROI, but require a small investment and save 1/4 million gallons a year.
Detailed cost estimates, savings and return on investment were compiled for each project.

“What if’s” became six tangible projects

Projected savings 12.6 Mgallons

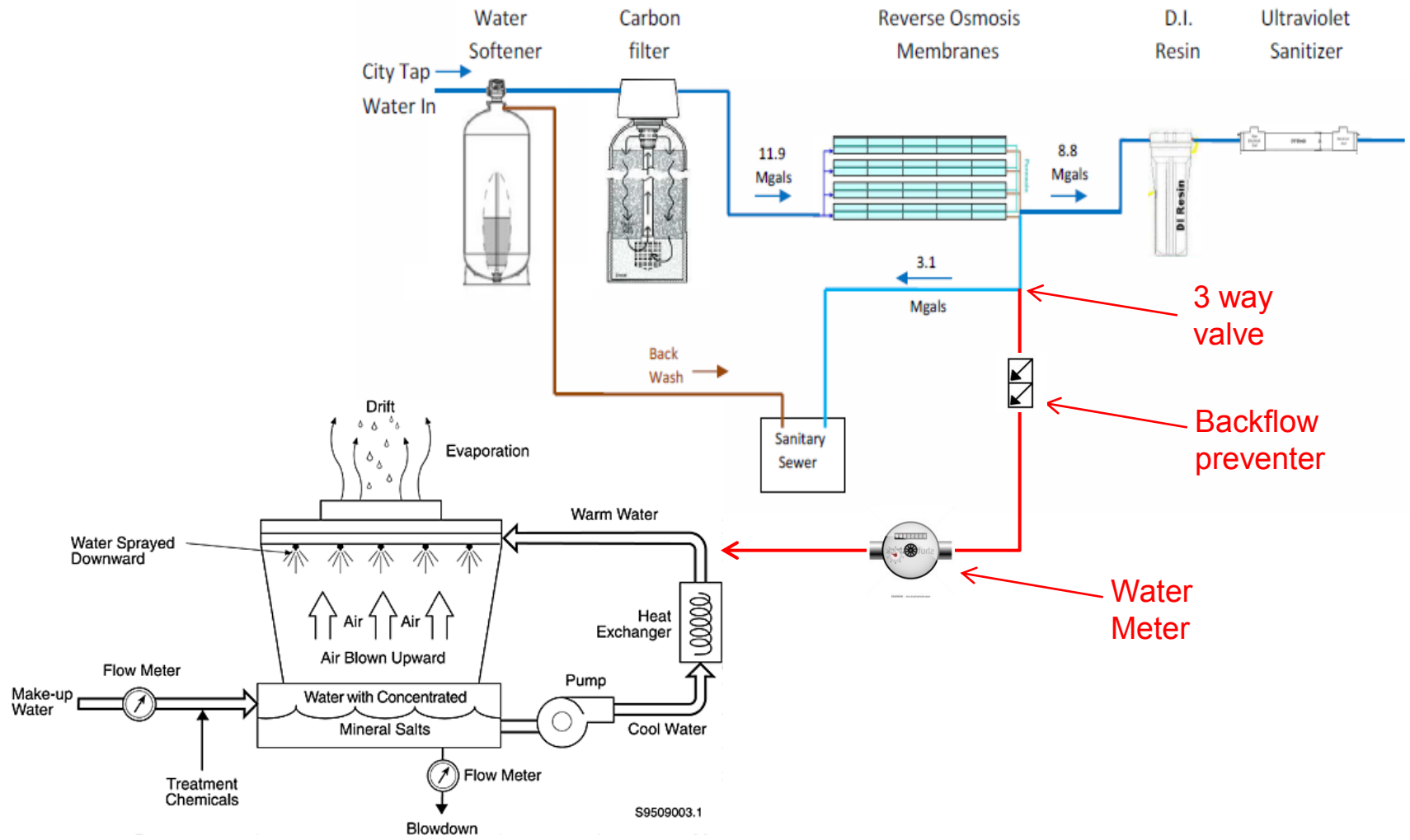
Project 1 - Replace Circuit Board Cleaner

- Eliminates one R/O system
- Lower machine operating cost
- R/O contractor placed system in storage condition for possible future use.
- Saves 1.05 Mgals $7,392 w/s
- ROI <2 years

Additional benefits:

- **Cleaner boards**
- **Improved efficiency**
- **Improved insurance risk score**

Projects 2 & 3 – Send 'Reject' Water from Two R/O Systems to the cooling tower



Projects 2 & 3 – Send 'Reject' Water from Two R/O Systems to the cooling tower

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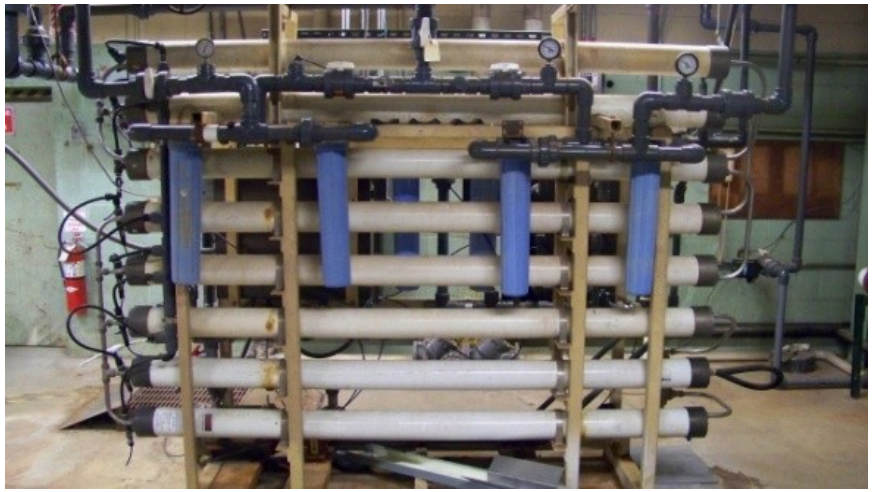

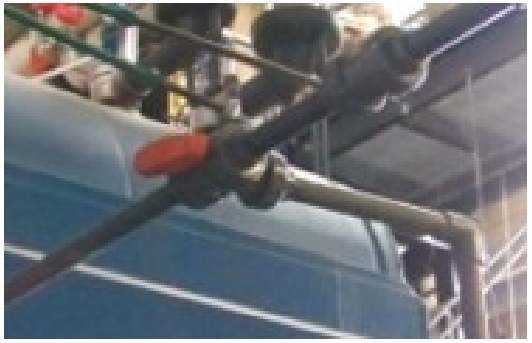

Backflow Preventer & water meter

Tower Water Return

Projects 2 & 3 – Send 'Reject' Water from Two R/O Systems to the cooling tower

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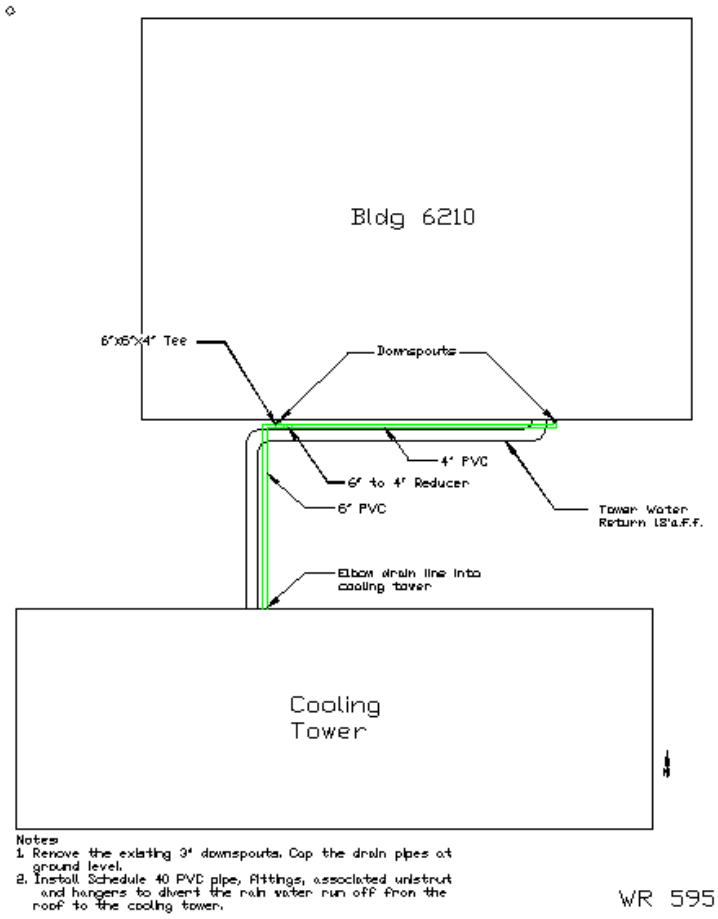
- Short connection runs
- Passive equipment
- Saves 2.79 Mgals $19,641 w/s
- ROI <14 months

Additional benefits:
- **better make-up water**
- **cleaner strainers**
- **reduced service and down time**

Projects 4 – 6 - Rainwater Harvesting

- Based on Indianapolis data:
  - Annual rainfall is 43 inches
  - Each square foot of surface can produce 27 gallons annually.
- Each building was given a quick assessment
  - Roof Square footage
  - Ease of harvest and transport
  - Estimated implementation cost
- Three buildings rose to the top
  - Chiller Building
  - Power House
  - Main building

Project 4 - Chiller Building



30’ from cooling tower

Roof sloped towards the tower

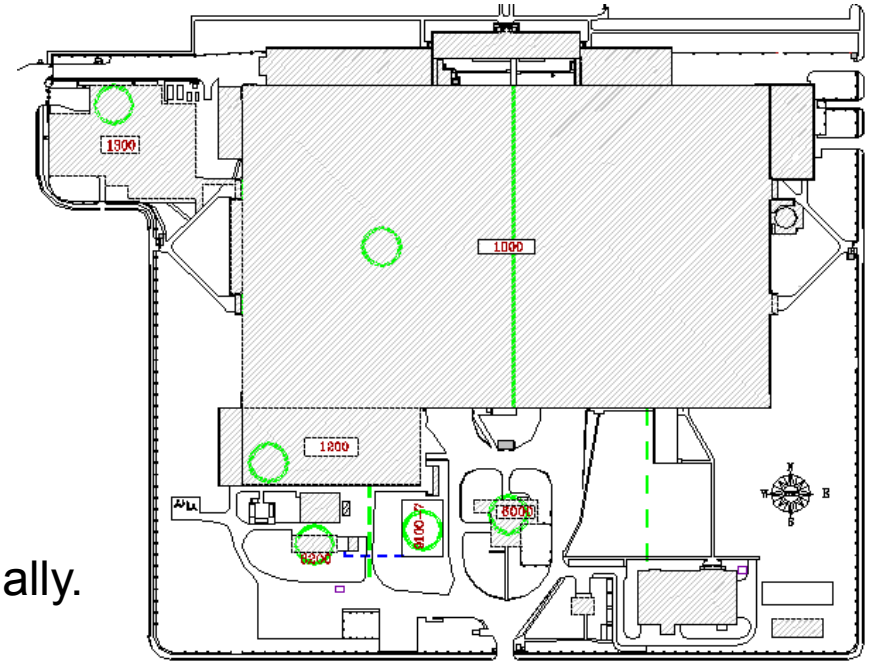
Existing supports between buildings

Project 5 - Power House - Pending

Two interior roof drains

Tie into existing piping carrying boiler R/O reject to cooling tower.

Project 6 - Main Building - pending



- Main building
  - 621 ksf
  - drains through two 24” pipes
  - One pipe lies within 60’ of a decommissioned ½ Mgal reservoir
  - Redirecting one pipe yields 9 Mgals annually.
  - save $21,420 in water fees
  - storm water credit for the watershed area of $1,841/yr.
  - ROI = 3 years
  - Connecting the second B1000 roof drain would double the rainwater harvested, but at a higher expense due to its location.

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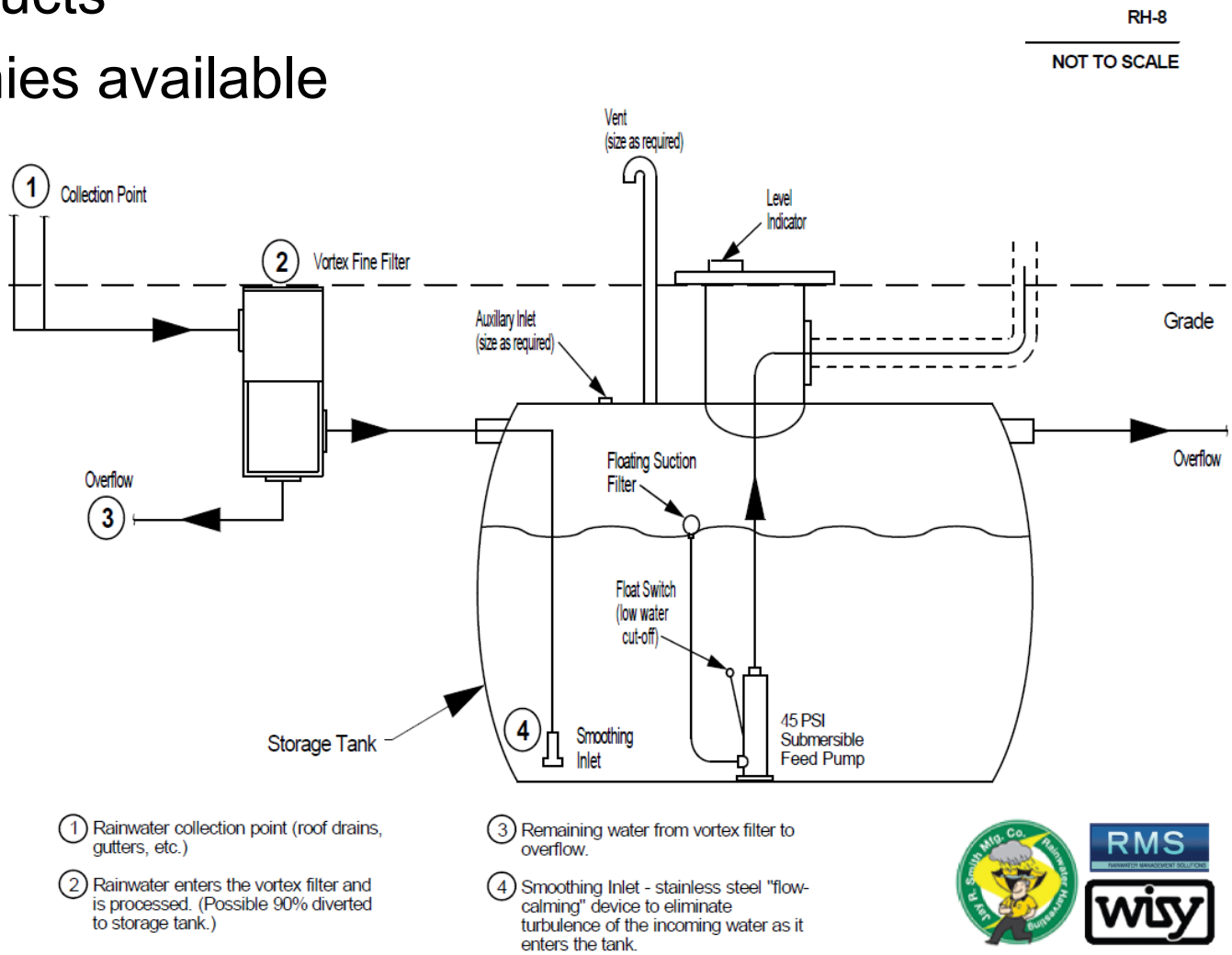
Conservation & Rainwater Harvesting

- Entire industry
- Innovative products
- Design companies available



Validate

- Meters on reclaimed water

  NOTE: Add these values to monthly evaporative credit

- Existing meters on make-up and blow down

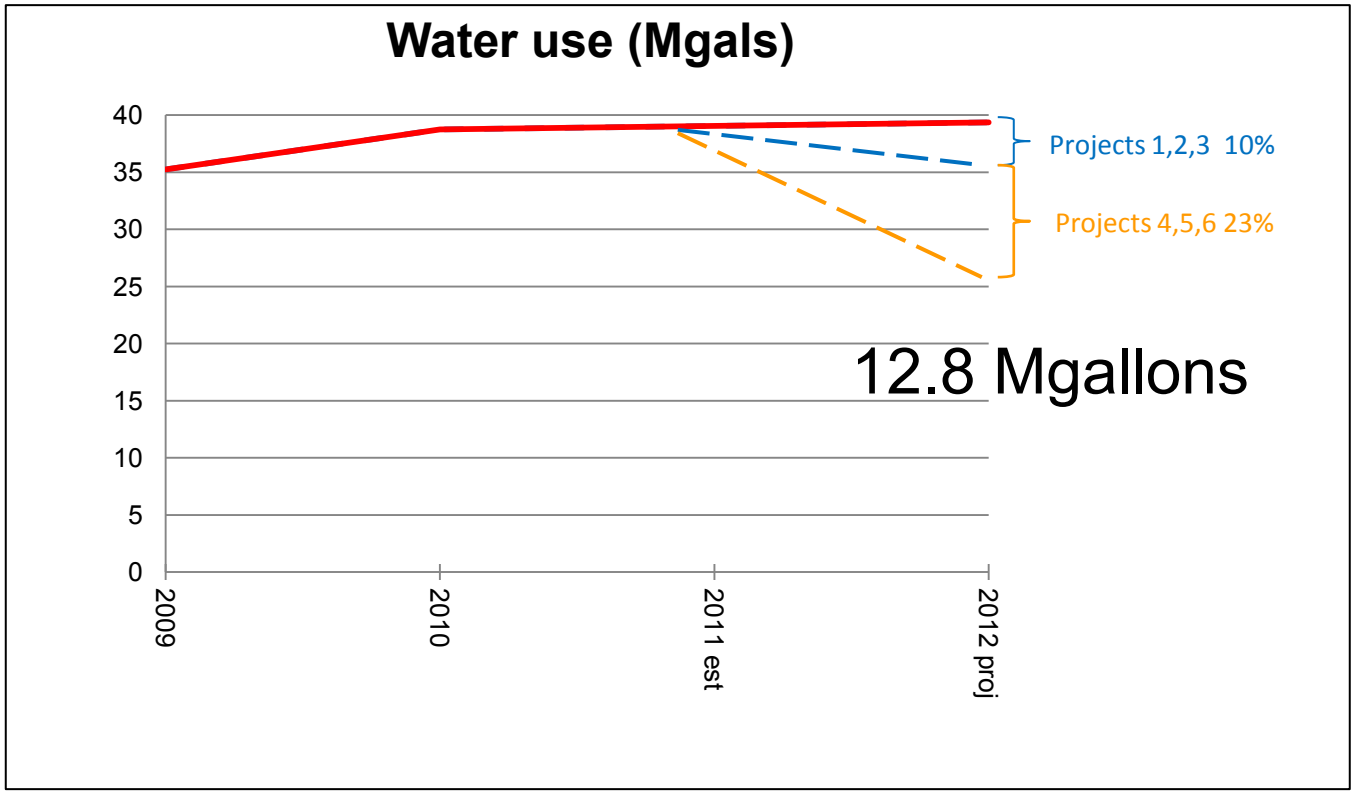
- Water invoices prior to and after conversions

Measured results

Achievements after 4 of 6 projects

- Reduced water purchased by 5.3 Mgals.
- Reduced sanitary discharge by 4.1 Mgals.
- Reduced storm water discharge by 1.2 Mgals.
- Exceeds our initial goal.

Projected savings after all 6 projects



Approach

- Look for opportunities everywhere water is used
- Keep an open mind
- What if?
- Explore all options before dismissing them

Conservation

- Demand and cost for clean water continues to increase
  - Growing populations
  - Climate change
  - Industry
- Evaluate Options
  - Innovative technologies
  - Review all waste streams for reduction
  - Alternative water supplies

Outcome

Raytheon became a better steward of the natural resources used in our local plant.